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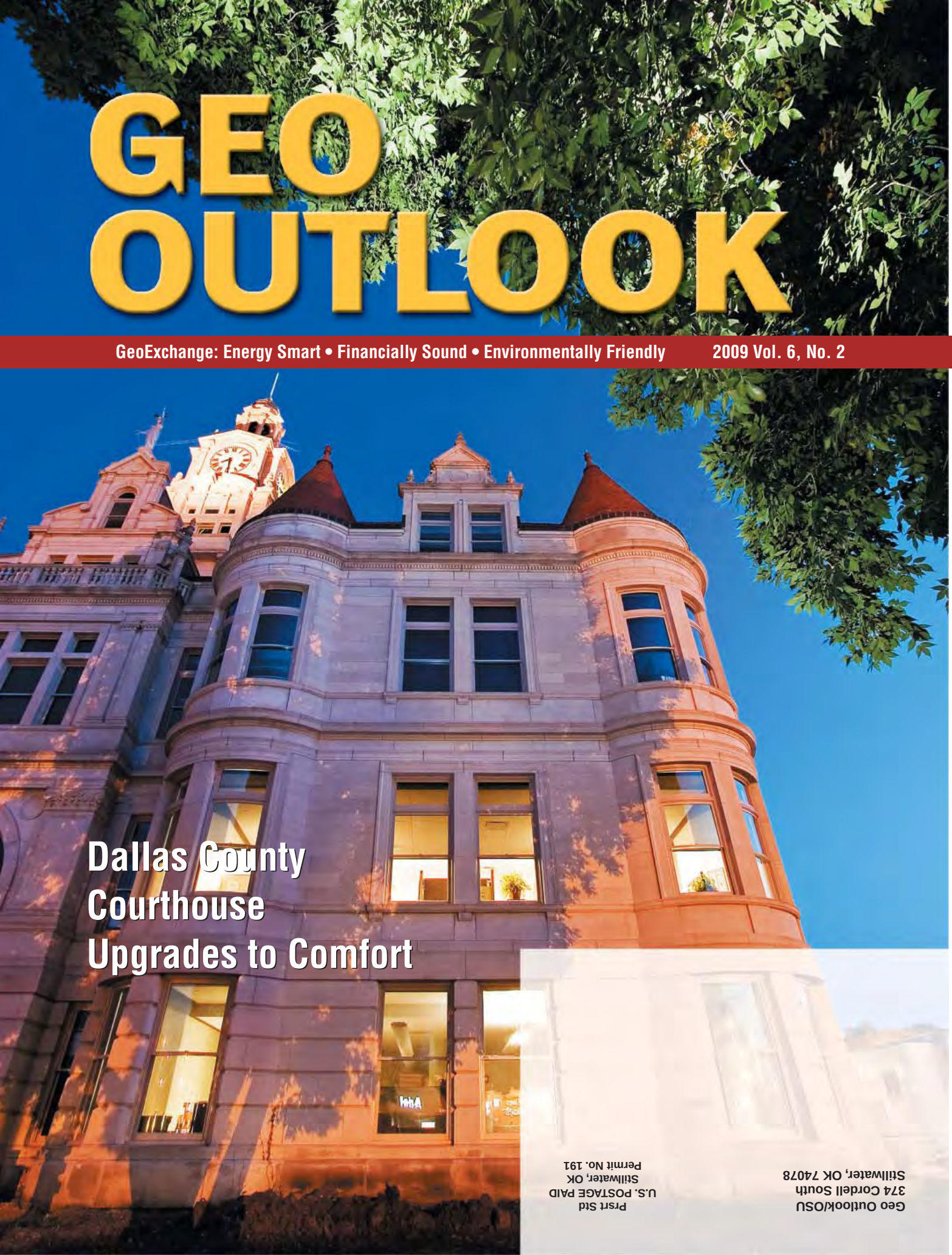

Dallas County Courthouse Upgrades to Comfort

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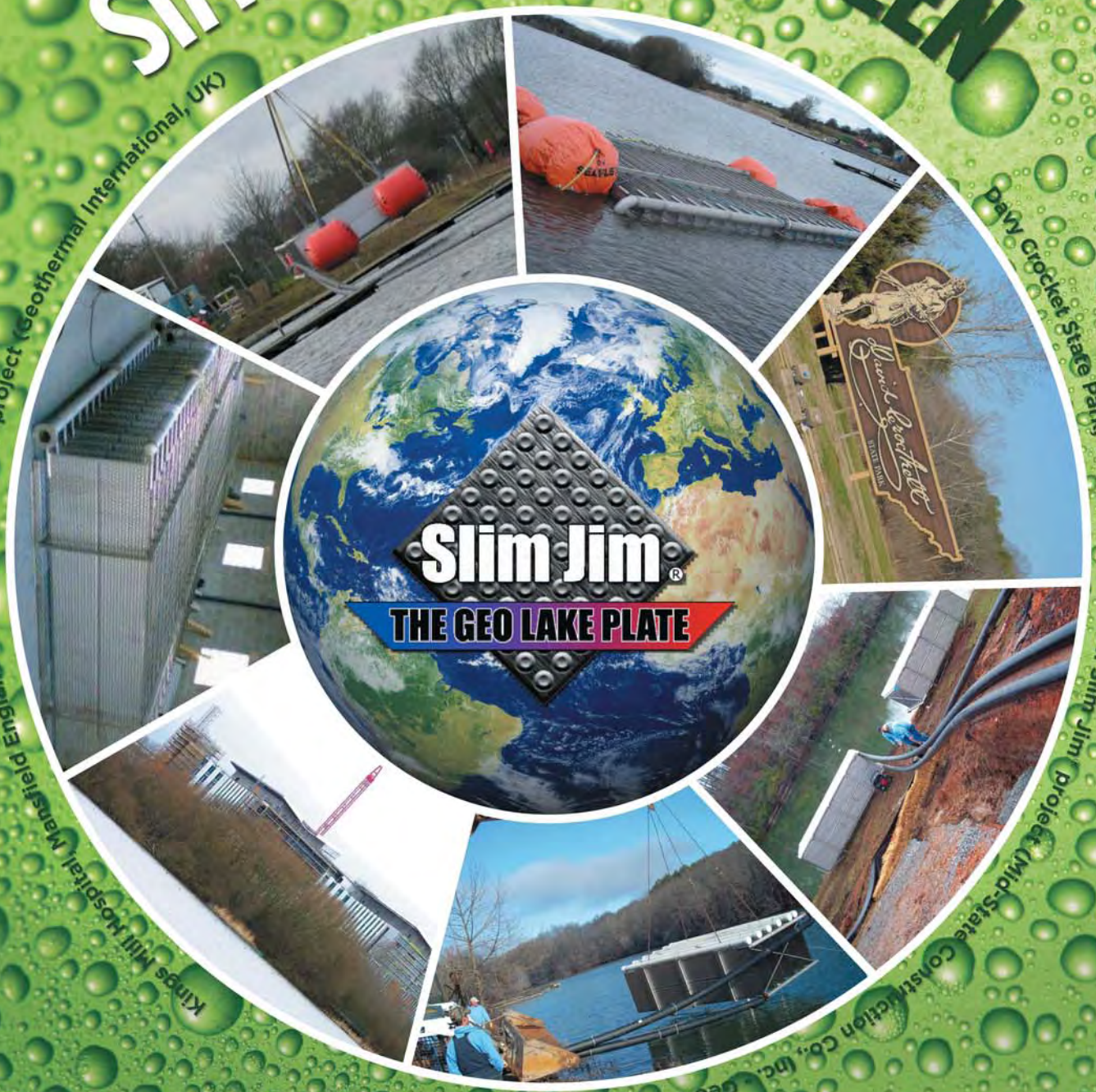

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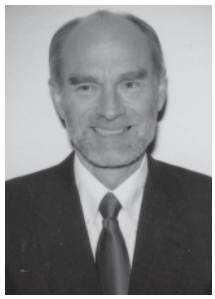


By John Kelly
Executive Director,
Geothermal Heat Pump Consortium

Public buildings and other governmental facilities face unique challenges and opportunities. Like commercial buildings, they must provide healthy and productive environments for the workers who spend much of their lives there. But in addition, many governmental facilities must also provide open and convenient access to the public, while other specialized facilities require unique safety and security features. Ground source heat pumps (GSHPs) excel in meeting these challenges.

In addition to providing quiet and comfortable working environments, GSHPs are scalable and robust heating and cooling technologies. In place of large central systems that demand redundancy for reliability, and complex control systems to assure energy efficient operation, multiple small GSHPs can be installed in strategic locations throughout a building to meet local demands, with easy-to-use controls operated by building occupants. GSHPs also avoid the taxing maintenance requirements typical of boilers and cooling towers, like ongoing chemical water treatment and scheduled downtime for periodic maintenance. And if one GSHP malfunctions, the remainder of the building's environmental equipment continues to operate normally while the malfunctioning unit is repaired or replaced.

And for those unique historic structures serving as government facilities, GSHPs provide the ideal retro-fit solution, since they require no roof-mounted or above-ground outdoor equipment, and a variety of different equipment styles can be selected to suit the structure's original architecture.

Ground source heat pumps offer much more than just the lowest life cycle cost.

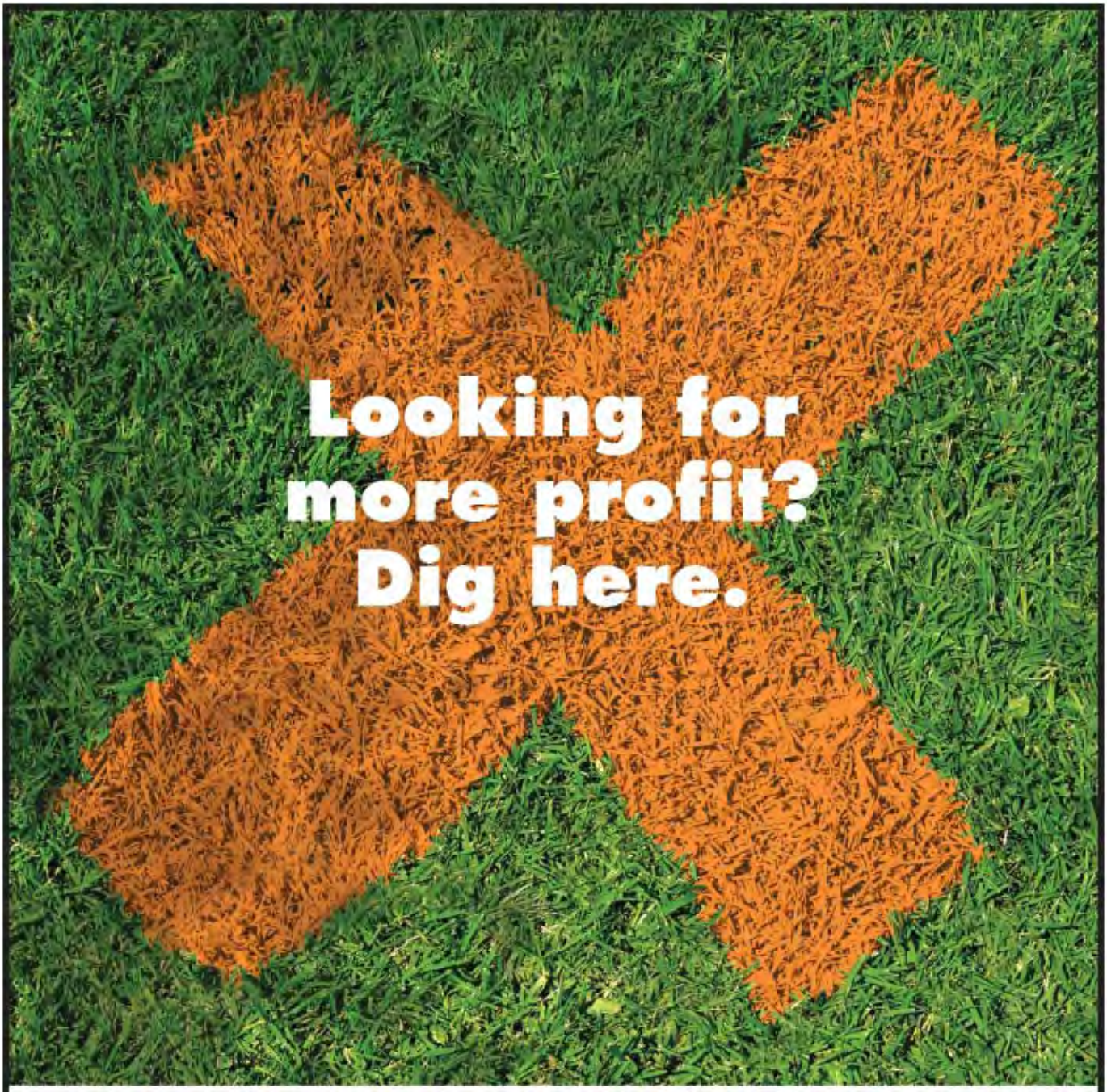
Notes from IGSHPA

By Jim Bose
Executive Director,
International Ground Source Heat Pump Association

The impact of stimulus funds here in the United States and its application to civic buildings will be greater than almost anyone would have imagined. This issue of *Geo Outlook* features broad applications to a variety of civic buildings. These infrastructure improvements that are long overdue will result in economic burdens being lifted on local, state and national governments operating energy budgets. The substantial operating savings and long demonstrated life is what has come to be expected of our industry.

Accountability to the many owners (general public) of a civic building is required. This is especially true in government buildings where the general public has more than a casual interest. Energy savings are not transparent. Energy efficiency is not easily recognized from the curb, but everyone knows about promises that are not met.

The IGSHPA *Geo Outlook* staff has the responsibility to feature outstanding projects that represent the best applications of this technology. It is encumbent upon the membership to make known to these professional writers the nature of our business and the fruits of our membership. Our projects, most of which are buried underground, need to look "store bought!"



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Joe Dobry has been with Baroid Industrial Drilling Products since 1994 and before that, Baroid Drilling Fluids since 1967. He has extensive experience in the formulation and application of all types of drilling fluids. Since joining Baroid IDP in 1994, he has worked with most all types of water well, drilled shaft, horizontal directional and now geothermal installers to assist with the use of bentonite and polymers in drilling and grouting operations. He is a current director and a past president of the Manufacturers & Suppliers Division of the Texas Ground Water Association, and is a member of the Kansas and Oklahoma associations, as well as the National Ground Water Association. He has been a member of IGSHPA since 1997 and is currently on the Standards Committee. He is an active contributor to the ongoing NGWA update of their "Guidelines for the Construction of Vertical Boreholes for Closed Loop Heat Pump Systems."

Trey Austin

Vice President and Director of Engineering
Geo-Energy Services

Austin graduated from Oklahoma State University where he began his interest for geothermal technology. His research at OSU focused on in-situ testing. Since graduation, he has succeeded in designing and consulting on domestic and international projects. Austin is known for his passion for sustainable projects, especially ground source heat pump (GSHP) applications. In 2006, he helped create an engineering design firm dedicated to GSHP technology. His expertise focuses on energy analysis and optimization of heating, ventilation and air conditioning (HVAC) design, operation, and commissioning and integrating technology-specific solutions. He has experience working on projects that range from homes and businesses to eco-tourism and more. He is currently working on Colorado Springs Fire Station 21 in Colorado Springs, Colo. installing a GSHP system that integrates solar thermal and solar photovoltaic.

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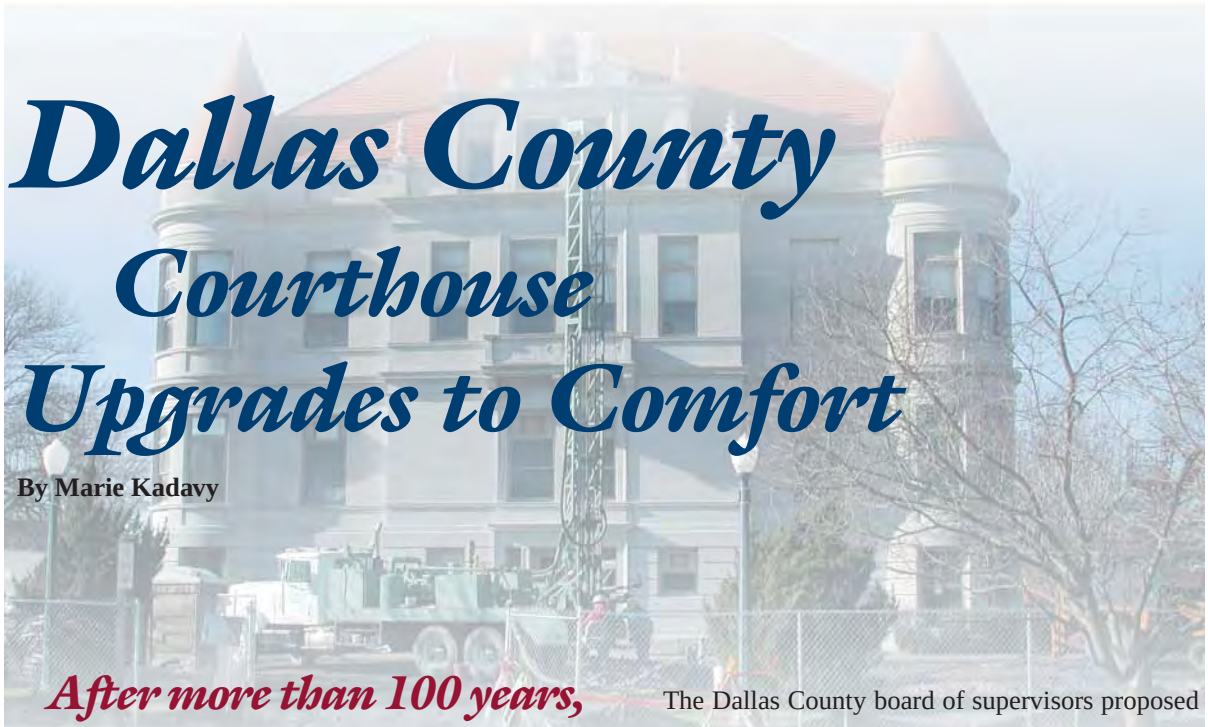

Dallas County Courthouse Upgrades to Comfort

By Marie Kadavy

After more than 100 years, the Dallas County, Iowa, courthouse needed an upgrade. With its original boilers and its French Chateau style fit for the National Register of Historic Places, the 44,000-square-foot courthouse received a $10 million energy-efficient restoration in 2008. The courthouse, known for more than its four courtrooms in Adel, Iowa, features a clock tower, a red-tile roof, eight turrets, and now, a ground source heat pump (GSHP) system.

Geothermal Solution

When restoring the courthouse, the primary goal was to increase structural support while maintaining the building's historic integrity both externally and internally, said Bill Clark, Dallas County Courthouse facility manager. The facility's restoration included replacing supports in the four-story building, as well as upgrading to energy-efficient windows and adding RenewAire energy recovery units (ERV) to exhaust the building and temper incoming outside air. In the remodeling process, as much of the original trim, flooring and art work as possible were retained, and the basic layout of the 1902 building also remained after the renovation was completed in April 2008.

The Dallas County board of supervisors proposed the installation of the GSHP system as part of the remodeling efforts, providing an energy-efficient solution for a comfortable environment while preserving the building's unique appeal. "The fact that we could remove the external cooling components from outside of the building, both out of the windows and off the ground allowed us to maintain the original look of the building and grounds," Clark said. The GSHP system is installed in areas that could be concealed from the public, yet remain accessible should maintenance needs arise.

In addition to being out of view, the system will aid in the restoration by protecting the building's finishes, said Randy Watts, project manager for Camblin Mechanical Inc. "The conditioning aspect of geothermal went well with the building's antique woodwork and finishes," Watts said. "Once the geothermal system gets the building acclimated, the finishes and woodwork will stand the test of another 100 years."

Watts is familiar with the technology having first worked on a commercial GSHP installation in 1994 and recently serving as the president of the Iowa Heat Pump Association. He also experiences the results first hand

in his geothermal heated and cooled home. This led Watts to believe a geothermal system was the right choice for the Dallas County Courthouse, too, he said. "Due to the fluctuating usage a courthouse gets, much like a school, geothermal is the most effective system at maintaining the environment when all is quiet," Watts said.

Being able to conceal the system's equipment fit the look of the building, but another concern of county officials was the work environment in the courthouse. Prior to the GSHP system installation, the courthouse was heated by two tube boilers that were located about half a block away in the sheriff's building. The previous boiler system was connected to the courthouse through underground pipes and used hot water registers for radiant heat. The first two floors were cooled by window air-conditioning units, and the top two floors were cooled via a large outside cooling unit, which was piped up the exterior wall to the fourth floor attic. The previous system did not provide adequate fresh air replacement. In fact, the only fresh air entering the courthouse came from opening windows, which negated any heating and cooling efforts, Clark said.

"Having 12 large window units running full blast during the cooling season made it awfully hard to hear," Clark said. "During the heating seasons, it was almost impossible to heat the rooms evenly because all registers were against the outside walls; thus, everyone had an auxiliary heater under their desks or fans running to circulate the air. Neither were cost efficient."

Clark expects the GSHP system to provide a 20 to 25 percent energy savings with a payback in five years or less. Although the energy efficiency of the GSHP system and subsequent utility cost savings were important factors in the county's decision, providing clean, fresh air and a comfortable, quiet environment for the public and about 120 employees was a priority. "The noise problem has been completely solved," Clark said. "We have gone to a more open floor plan and enlarged work areas putting different departments closer together. This system has eliminated the noise factor and the communication between employees and customers has improved greatly both in person and on the phone."

The Dallas County Courthouse restoration incorporated energy-efficient features while maintaining the building's historic character through original trim, floors and artwork.

Geothermal Installation

The 85-ton closed-loop system required 40 300-foot boreholes, which Enivro-Tec Inc. drilled in the courtyard east of the courthouse. A 20 percent mix of deionized water and propylene glycol circulates through the vertical system's 1-inch polyethylene pipe. The boreholes are headered in the 4-foot crawl space of the facility and disperse from there. The system's ClimateMaster Tranquility units range from 3/4 to 5 tons, including 29 water-to-air units and one water-to-water unit for domestic hot water. The system incorporates reverse return piping and variable speed main pumps controlled by the pres-

Installation of the courthouse's ground source heat pump system eliminated the need for window units and a large outdoor cooling unit.

sure differential on the third floor, Watts said.

"One of the biggest challenges for the team was to install a register system in the main courtroom that blended in and conditioned the space," Watts said. "We are pleased with the results."

With the exception of the main courtroom's twinned units, each heat pump operates on its own programmable thermostat. The ERV units are integrated with the occupied and unoccupied programming of the thermostats and run with the occupied mode of the building, Watts said.

A combination of 29 ClimateMaster Tranquility water-to-air units heat and cool the four-story courthouse.

Geothermal Neighbor

The neighboring sheriff's building and jail also recently upgraded to a geothermal heating and cooling system in January 2009. Built in 1989, the 18,000-square-foot facility was previously heated and cooled by an air-cooled chiller and a gas-fired boiler. The geothermal installation provided a new hydronic system and replaced the air-cooled chiller with a water-to-water heat pump, picking up roughly 80 percent of the heating load in the winter. A GSHP system was the best way to replace the existing system with the amount of space available, said Dan Stewart, professional engineer of Gilmor & Doyle and the project's primary mechanical engineer and designer.

"The existing system was such that it made the most sense to stick with a chilled water and hot water system, and with the owner's desire to have geothermal, it made sense to go with a geothermal water-to-water heat pump to supply all of the chilled water and a majority of the heating water," Stewart said. "On the coldest days, we have a backup boiler system, which I don't believe they ran very much this winter time. It was actually a very cold winter, but I think there were only a few days where they turned on the boiler to provide a little supplemental heating. The majority of the heating was done with the water-to-water heat pump system."

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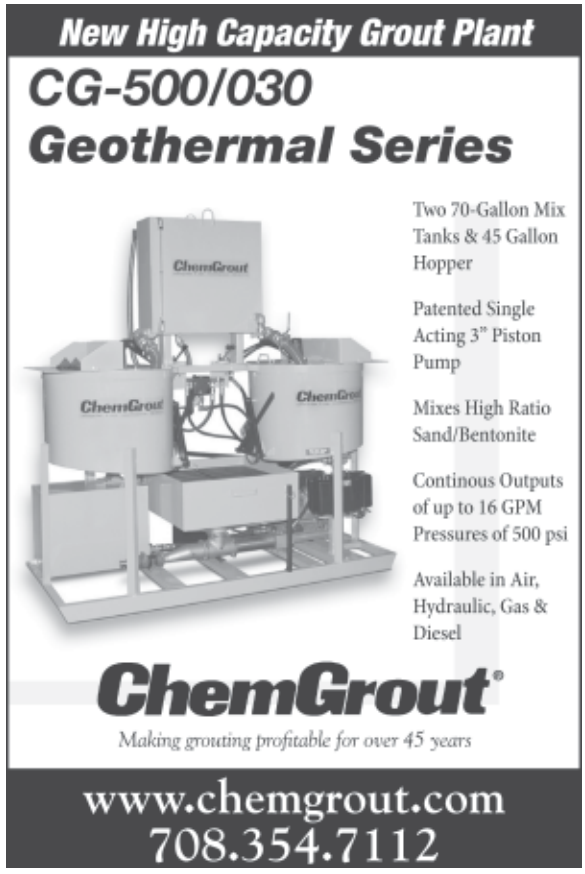
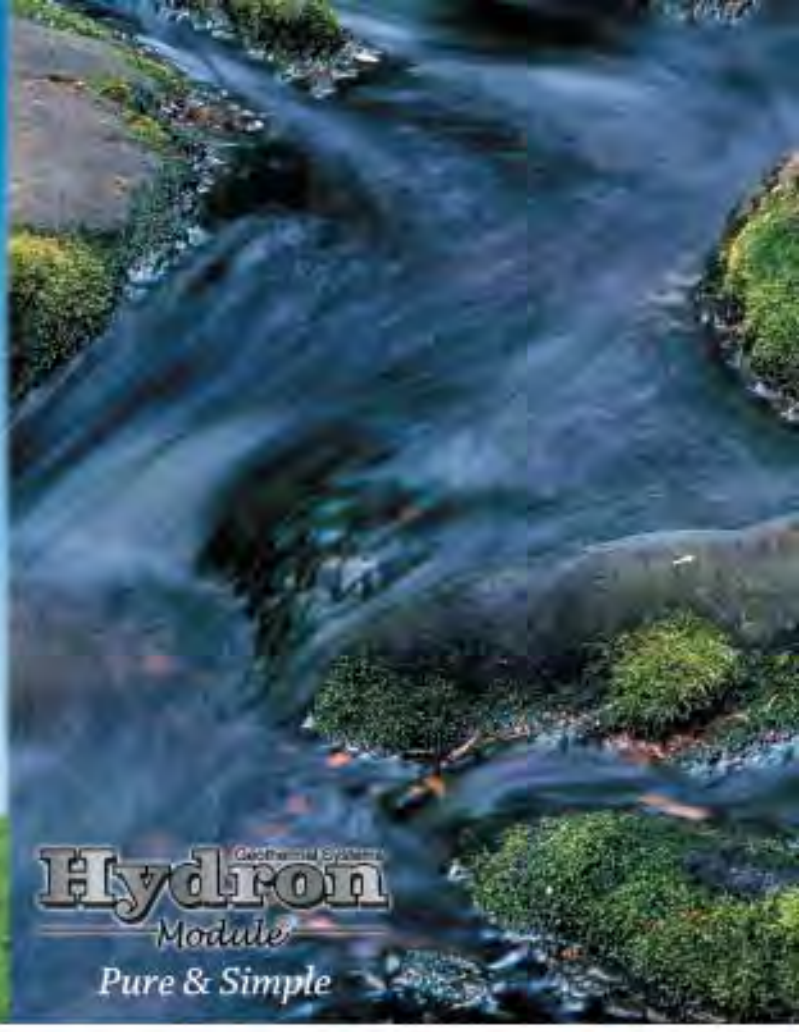
Two 20-ton ClimateMaster water-to-water heat pumps required 42 300-foot boreholes near the courthouse. Stewart said the biggest challenge was laying out the borefield in a tight space while trying to avoid killing trees. He estimates the sheriff's building and jail's system will also save approximately 20 to 25 percent in utility costs.

Geothermal Future

The courthouse's GSHP system not only provides savings and comfort for the public and county employees but also a solution to preserving the building's historic nature. "We feel that this system has answered 99 percent of our heating and cooling problems," Clark said. "The other one percent is in educating employees as to the benefits and operation of geothermal systems." Watts thinks the Dallas County board put the taxpayers' money to the best possible use. "Their decision will stand the test of time and provide the county a courthouse to be proud of," Watts said. ◆

Photos courtesy of Dallas County, Iowa.





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Idaho Capital City of Boise Heats Up in 1890

First Geothermal Heating District in US

By Linda Allen

Building 44, the pharmacy building, is one of 30 buildings located on the 60-acre campus of the Boise Veterans Medical Center complex, in Boise, Idaho. Seventeen of the stately buildings are on the National Historical Register.

If "location, location, location," is the formula for success according to real estate and business promoters, then Boise, the capital of Idaho, sits on prime real estate. An aquifer of geothermal water 400 feet below the surface keeps Boise in hot water – and that's a good thing. With temperatures averaging 170 degrees F, the hot water provides heat for the city.

Boise capitalizes on this natural resource with four geothermal districts in the city: the Boise Warm Springs Water District System (BWSWD), the City of Boise, the Capitol Mall Complex and the Boise Veterans Medical Center. Ken Neely, technical hydrogeologist at the Idaho Department of Water Resources, describes a geothermal district as one that distributes heat to end users using a system of production wells, heat exchangers and injection wells.

"The water temperature is between 154 and 175 degrees. There's a lot of heat in that water," Neely said. "The production wells pump water from the aquifer to the surface. Heat exchangers remove heat from the water and change it into a heating fluid, which is distributed through underground delivery pipes to end-users. Injection wells receive the cooled geothermal water and reinject the expended water back into the aquifer."

Each system operates independently with its own production wells to bring hot water to the surface. In total, the four districts withdraw approximately 775 million gallons of geothermal water annually from the aquifer to service over 200 homes and 85 government buildings and businesses. Wells range from 400 to over 3100 feet in depth.

The BWSWD claims the distinction of being the first geothermal district heating system in the U.S. In 1890, the year of Idaho's statehood, the Boise Water Works Company drilled two wells to capture hot water from the aquifer as a heating source using the technology of the time. In 1892, the Boise Natatorium opened a 15,000 square foot structure with a 65 x 125 foot geothermal swimming pool. It operated until 1934.

From 1892 until the 1970s, there was minimal development of geothermal resources in Boise. But the oil crisis of the '70s changed that, spurring new exploration, development and technology.

Boise's first convert to geothermal heating was the Capitol Mall Complex. By 1982, the system supplied heat to nine buildings including the State Capitol, the only state capitol building in the nation heated by geothermal water. The system consists of a production well, heat exchangers, underground delivery system and an injection well. The production well is 300 feet deep with water temperature of 155 degrees. The system currently heats over 1.5 million square feet.

Photo provided by Kent Johnson, Public Works of Boise

Idaho Elks Rehabilitation Hospital uses 170 degree geothermal hot water supplied from one of Boise City Public Works' deep geothermal wells to heat the facilities 156,000 square-feet building.

The City of Boise system is 26 years old. It was designed and built on the assumption that everyone would use it. But, when it came on line, natural gas prices went down making natural gas the more economical and popular heating choice. Only 20 customers signed onto the system in the beginning. In 1986, the city created an incentive for customers to connect to the system by tying geothermal rates to natural gas rates for a 30 percent savings. Through the years, the customer base has grown and with current natural gas rates, the city system is now self-sustaining, according to Kent Johnson, geothermal coordinator for Public Works of Boise.

The City of Boise runs a dual geothermal system with supply and return lines to over two million square feet. The city system supplies heat to 58 customers, including Boise City Hall, Ada County Courthouse and the Idaho Water Center. Additionally it serves private businesses, churches, schools and medical facilities. A challenge to expanding the system is the $100,000 cost per city block, most of which is construction costs.

Leaks caused by corrosives in the water and the distribution lines are common maintenance problems in the sys-

Photo by Barbara Peterson, Boise Veterans Medical Center

tem. Johnson said replacing pipes with nonmetallic fittings or placing the lines in non-metallic vaults prevents leaks in the system. New construction uses stainless steel.

The fourth district to come on-line was the Boise Veteran's Medical Center in 1988. Its campus stretches over 60 acres with 30 buildings, 17 of which are listed on the National Historic Register. NHR requirements create a challenge for energy upgrades because they dictate the type of construction allowed and limit exterior changes to maintain the historic character and integrity of the buildings.

Over a 20-year period, the hospital established energy goals to lower consumption, increase efficiency and save money. The facility's conversion to geothermal energy for heat and hot water created the largest reduction. The anticipated payback of eight years was achieved in only five. In its 20-plus year history, the system has operated virtually trouble free. The hospital earned an Energy Star Award from the Environmental Protection Agency in 2002 as a top energy performer among hospitals in the US.

The system is made up of a supply well that pumps

Photo by Barbara Peterson, Boise Veterans Medical Center

Jim Beatty, facility management technician with the Boise Veterans Medical Center, checks the main production well pump. Water between 160 and 164 degrees is pumped up from the 1666- foot well to operate the hospital's system

Photo provided by Kent Johnson, Public Works of Boise

Boise City Hall is also part of the heating district, and utilizes the city's dual geothermal system that provides supply and return lines to serve over two million square feet of space for other city, county and private locations.

from 2200 feet in the geothermal aquifer, an injection well and a single loop layout to the 30 buildings. Direct geothermal water supplies six buildings. The remaining 24 use heat exchangers.

When the three additional systems came on-line in the 1980s, the increased use caused water levels in the geothermal reservoir to decrease. To protect its natural resource, the Idaho Department of Water Resources established the Boise Front Low Temperature Geothermal Resource Groundwater Management Area. Each system is required to use injection wells to return the expended water to the reservoir. Currently about 70 percent of the water is reinjected into the aquifer according to Neely.

There are approximately 37 other hot spots in the United States with potential to withdraw geothermal water for heat. The geologic structure of the earth determines the location of these hot spots, most of which are in western states.

Geothermal water, often referred to as the "Big G" in industry language, can be trapped below the earth's surface or escape through geysers or drilled wells. Most

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are located along plate tectonics of the earth's crust. Faults or breaks along the plates are known for causing volcanic and earthquake activity. They also allow geothermal water to move upward.

The Ring of Fire, a horseshoe-shaped area that outlines the Pacific Ocean is a series of volcanoes, earthquakes and plate movements. Geothermal reservoirs are also part of the Ring of Fire and extend hundreds of miles inland from the perimeter, including Idaho's aquifer.

Idaho's location takes advantage of the faults along these boundaries to provide conduits for geothermal water to move upward. Neely said, "A successful well needs hot water from the fault system or from the aquifer. The closer to the fault, the hotter the water and the shallower the well needs to be. The fault lines were where the first wells were drilled. Most older wells are only 500 feet deep. As you move further away from the fault, the wells have to be deeper to capture the hot water, which is where most newer wells are."

Boise's geothermal future continues to be hot. President Obama signed a general spending bill on March 11, 2009 that will provide the City of Boise $2 million to expand its geothermal heating system to the Boise State University campus. Five buildings are scheduled to be retrofitted with a geothermal heating system, which is anticipated to save the university $80,000 annually in energy costs. ◆

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LEED 2009 and Geothermal

By Janet F. Reeder

A look at the latest update to LEED, the Leadership in Energy and Environmental Design Green Building Rating System, reflects that the LEED 2009 or version 3 program changes still do not specifically address ground source heat pump use, but a realignment of energy credits may still prove beneficial to the industry.

New LEED Version Updates Energy Credits

In the past, LEED for New Construction Rating System version 2.2 points awarded for the Energy and Atmosphere category under Credit 1–to Optimize Energy Performance, have included a total of 10 possible points available. The points are awarded after meeting three prerequisites including commissioning of the building energy systems, a minimum established energy performance and the fundamental refrigerant management requirements. The use of GSHPs would be factored into this area.

The newest and now current, LEED 2009 for New Construction and Major Renovations, version 3, raises the total for the same area to 19 possible points, also after the three prerequisites have been met.

Maury A. Ross, with the architecture and engineering firm Crafton, Tull, Sparks and Associates, Inc., says changes to LEED, an eight-year old program, should make the rating system easier to understand. He believes the efforts have "streamlined" the system. Ross also notes efforts have been made to make reference guides available in "e-copy" format. Ross is often asked to explain differences in LEED and other rating systems. A move toward international standards is under way.

Possible points for the Energy and Atmosphere category in LEED 2009 version 3 now totals 35. Version 2.2 carried 17 total points. Nine of those new points for version 3 have been added to the Credit 1–Optimize Energy Performance area.

LEED 2009 Rolled Out

A third-party certification program and the nationally accepted benchmark for the design, construction and operation of high performance green buildings, the United States Green Building Council's Green Building Certification Institute, LEED 2009, also known as version 3, launched April 27, 2009.

The newest version of the comprehensive rating system continues to incorporate sustainable practices while providing building owners and operators with the necessary tools to measure and impact performance. USGBC is a non-profit organization of more than 15,000 building industry groups working to promote environmentally responsible and healthy places to live and work. Members include government agencies, non-profits organizations, subcontractors, general contractors, owners and end-users, real estate developers, product and building system manufacturers, facility managers, architects, designers and engineers.

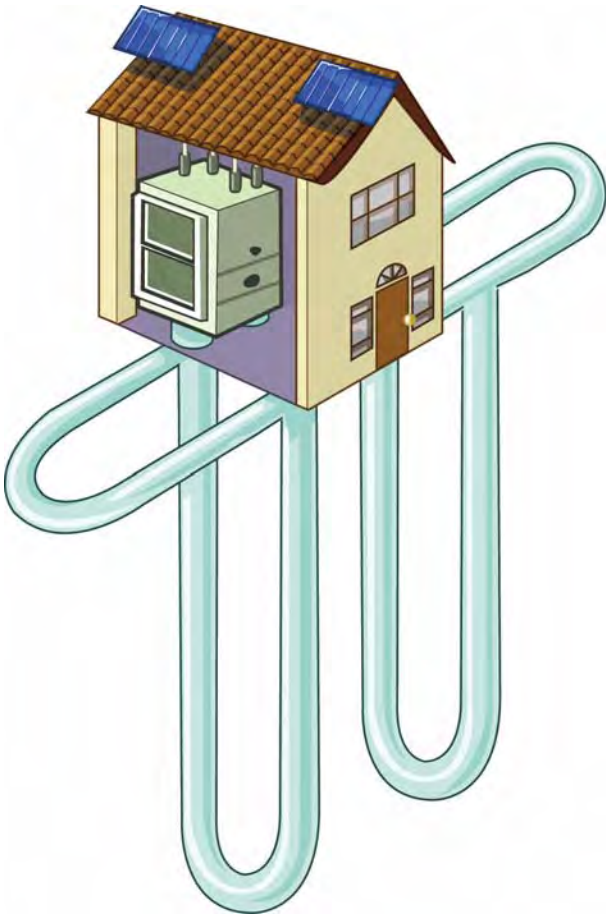
"The conclusion of the balloting process marks the culmination of tireless work done by representatives from all corners of the building industry," says Brendan Owens, vice-president, LEED Technical Development, U.S. Green Building Council. "We have the deepest gratitude for our volunteer leaders, and for their bold steps towards resetting the bar for green building leadership and challenging the industry to move faster and reach further."

Prerequisites and Credits Realigned

Three noticeable changes in the LEED 2009 update include a prerequisite credit alignment, transparent environmental-human impact weighting and regionalization.

In the consolidation and realignment of LEED credits and prerequisites, efforts were made to reflect their most effective common denominator, providing a consistent pool of prerequisites and credits across the commercial and institutional LEED rating systems. Existing Credit Interpretation Rulings (CIRs) were also reviewed and precedent-setting and clarifying language was added to the prerequisites-credits.

Revised credit weightings for environmental-human impacts allow more points for strategies that will have greater positive impacts on energy efficiency and CO2 reductions. Each credit went through evaluation against 13 environmental impact categories that included climate change, indoor environmental quality, resource depletion and water intake along with other categories.



Experts prioritized credits and assigned values based on contribution to mitigation of each impact.

The realignment of credits and five corresponding possible points in the Innovation and Design Process of Version 2.2, has with Version 3 seen one point added to a total six points now possible. Sustainable Sites as a category went from Version 2.2's 14 possible points to Version 3's new total of 26 possible points.

More emphasis has been placed on Development Density and Community Connectivity, Alternative Transportation-Public Transportation Access, Alternative Transportation-Low-Emitting and Fuel-Efficient Vehicles and Alternative Transportation-Parking Capacity.

The Water Efficiency category has also increased from the early version's five possible points to Version 3's new total of 10 possible points. Water Use Reduction has become a prerequisite, while both Water Efficient Landscaping and Innovative Wastewater Technologies were increased. An additional four points are also possible in the Water Use Reduction category, reflecting past points for 20 percent and 30 percent reduction.

Growing Interest Among Professionals

Ross credits a Tulsa, Okla., town house project by architect Shelby Navarro called NINE, for increasing his interest in geothermal heat pumps and that of professionals he works with in Oklahoma, Kansas and Arkansas. He said that the project, the first LEED platinum project in Oklahoma, and a cover story for the last issue of Geo Outlook, has really attracted the interest of professionals who were not familiar with the advantages of ground source heat pump technology.

During construction on NINE, Ross visited the site to observe what Navarro incorporated into the project that earned such a high LEED rating.

He says that even though GSHP technology has been developed for a number of years, it is not as established as the more conventional standard heat and air systems that have been in mass production for years.

Changes in the economy and in energy costs are always reflected in the building industry due to the investment involved. Ross says that he steers away from "buzz" words like sustainability and green when talking to the public because they still carry "tree hugger" or "hippie" connotations to many in this region. He sees that a number of promising technologies from GSHP to solar and even wind, while promising on the energy conservation spectrum, continue to be hard to sell primarily because of up front costs.

"It is making people stop and rethink how they do things. Retail is down and people are sitting on their money. They are trying to figure out how to save money where they can. People on the outside of our profession are starting to understand things like life cycle investment," Ross said. He is fielding more questions about return on investment and energy efficiency.

LEED's project wide energy efficiency rating takes into account the use of GSHP technology, even though additional credit for their use is not given, Ross said.

Because GSHP technology does not produce renewable energy, a new total of up to 7 credits, up from version 2.2's three credits, does not apply under Credit 2– On-Site Renewable Energy.

Actual wording from the LEED 2009 reference material states:

> *Geothermal energy systems using deep-earth water or steam sources (but not vapor compression systems for heat transfer) may be eligible for this credit. [EA C.2] These systems may either produce electric power or provide thermal energy for primary use at the building.*
>
> *Geo-exchange systems (geothermal or ground source heat pumps) are earth-coupled HVAC applications [that] use vapor-compression systems for heat transfer and do not obtain significant quantities of deep-earth heat. These systems are not eligible as renewable energy systems. he contributions of these systems are reflected in project-wide energy efficiency levels and facilitate the achievement of EA Prerequisite 2 and EA Credit 1.*

Guaranteed Watt Saver Works with LEED

Andrea Fair works with LEEDS daily as the national programs coordinator for Guaranteed Watt Saver Systems, Inc. GWS is an engineering, consulting and inspection firm specializing in energy efficiency engineering and building science consulting. As one of the nations leading firms supporting builders around the country, Fair says GWS, "has been making green happen every day since 1986."

LEED is the most stringent of the standards programs GWS works with doing third party consulting and inspecting. GWS works with the National Association of Home Builders (NAHB) in their Green Builders program, the Department of Energy Builder's Challenge, the Home Energy Rating System (HERS) and Energy Star programs, among others. Fair says that LEED ratings are based on a 100-point scale, except for residential homes. "Homes still have the 136- point total." She says LEED plans changes to the LEED for Homes program for 2011.

Weaknesses in the LEED ratings for commercial buildings in the past have been a contention for many professionals who saw developers "gaming" the system by bulking points for features like bike racks, light pollution reduction and recycled roofing as opposed to actual energy saving features.

"You could have what was considered a green building and it still not be energy efficient," Fair said. She sees the changes in credit weighting addressing those issues in LEED 2009.

Experts are seeing the program mature and become more adaptable to project types and regional climates, as well as a move toward adjusting credits to more accurately reflect impact. Building owners, designers and government officials will be making more informed decisions based on the new standards in LEED 2009 set to reward building practices that are truly energy efficient.

The first LEED certified home in the United States was built by IDEAL Homes in Edmond, Okla., Fair says. LEED programs for commercial buildings began with a pilot program in 1998. LEED introduced a residential rating program in 2006. The USGBC Web site states that more than 1,800 homes have been LEED certified, and over 9,000 have been registered and are under development. ◆

Illustrations by Hannah McGill.

Blue Earth County Justice Center

By Megan Wible

With the help of a ground source heat pump system, the Blue Earth County Justice Center is set to be the first public LEED-certified building in south-central Minnesota at its completion.

Blue Earth County is changing its color from blue to green as it becomes a leader in environmentally friendly technology and sustainability. The Blue Earth County Justice Center in Mankato, Minn., will house the sheriff's department, county attorney, corrections department, the courts and even a 196-bed jail.

The new center is 172,000 square feet and an average of 400 people will be moving through it daily, county administrator Dennis McCoy said. When completed, the justice center will be the first public LEED-certified building in south-central Minnesota. The building's silver status is being achieved, in part, by a ground source heat pump (GSHP).

The facility's ground source heat pump system met LEED requirements for indoor air quality.

An Easy Decision

The Blue Earth County board of commissioners looked to geothermal for a number of reasons. First, they saw the chance to become leaders. "The county board wanted to demonstrate environmental leadership and so they seized the opportunity," McCoy said. "We wanted people to see the operational efficiency of a LEED building."

A geothermal system fit the center's complicated heating and cooling needs. "Jails are by necessity very hard, very dense, very tight, and so they tend to be hot," McCoy said. "The biggest challenge was figuring out how to dissipate the heat we expected from the jail." The use of GSHPs allowed the incorporation of snowmelt, which effectively dissipated a considerable amount of heat coming from the jail. The building is designed and sited to allow for expansion on the jail and the current geothermal system will be able to support needed expansions.

When it came to putting a GSHP system in the new building, the board had no hesitation. The decision was made without even knowing whether they would be eligible for utilities or incentives. "Utilities and incentives were not a deciding factor," McCoy said. "The county board was determined to do this whether there were incentives or not." Currently, Blue Earth County has a pending $70,000 incentive from local utility CenterPoint Energy.

Wanting to see geothermal first hand, the board headed south. About three hours south of Blue Earth County, Story County, Iowa, had used a GSHP system successfully in its jail and other public buildings. Blue Earth County board members thought touring the facility was the perfect opportunity to see what a GSHP system could do for them.

Touring Iowa's facility was the driving force behind the decision to use geothermal. "The board was confident that we could figure out how to do it and soil conditions at the site were favorable," McCoy said.

The 400-ton system required 500 boreholes and 48 miles of high density polyethylene pipe.

First Time for Everything

The geothermal aspect of the project was a first for many involved, including the county and the architectural firm, Paulsen Architects. Paulsen Architects did not have any LEED certified staff when the project was in the initial stages so they partnered with Blue Earth County to hire a consultant to help with the process. "Now they have half a dozen people who have been through training and certification," McCoy said. "I think it's great for our community."

With heat pumps manufactured by Florida Heat Pump, the 400-ton system contains 164 water-to-air units with various capacities from 3/4 ton to 12 tons each. Also, seven water-to-water heat pumps are being used for the radiant in-floor heating and snowmelt systems. There is another water-to-water heat pump being used solely for domestic hot water.

"The water-to-air heat pumps have caused some challenges due to the quantity of these units that are above the ceiling," project manager Greg Borchert, of Paulsen Architects, said. Still, Borchert sees many benefits in geothermal.

"During the design phase of the project we performed energy modeling and easily saw the tremendous benefits of this system," he said. "The advantages include an economical way to utilize in-floor heat and a snowmelt system, which will assist in maintenance and extend the life of the borefield."

The initial test bore was drilled 230 feet deep to bedrock. The test concluded that the first four feet of dirt was topsoil, five to 210 feet was clay, and 211 to 230 feet was sand and gravel. The thermal conductivity of the test bore was 1.34 Btu/hr-ft-F with an undisturbed soil temperature of 48 to 50 degrees Fahrenheit.

Facts and Figures

The borefield, which was completed in the fall of 2008, contains 48 miles of high density polyethylene (HDPE) piping. The largest majority of pipe–220,400 feet–is one inch in diameter. The borefield includes pip-

The Justice Center, which includes a 196-bed jail, has a number of water efficiency features.

ing all the way up to 10 inches in diameter. Ten circuits with a diameter of four inches each were used to connect to 50 of the bores. The vertical closed-loop system has 500 boreholes drilled 220 feet deep. The 5-inch bores were drilled 20 feet apart.

Because the borefield was completed in the fall, the in-floor heating system was utilized as a temporary heat source during construction. "This assisted us with our indoor air quality during construction," Borchert said. "The system allowed us to gain the LEED point for indoor air quality."

LoopMaster International Inc. from Indianapolis, Ill., installed the system. The center is expected to reach beyond the American Society of Heating and Air-Conditioning Engineers (ASHRAE) standards with an estimated energy savings of 24 to 32 percent.

The borefield cost $1.2 million, and the mechanical system added about $300,000 due to its unique nature. "It was unique as opposed to a conventional method because we used a boiler-chiller system and so there was some additional cost on the front end," McCoy said. The system, however, will pay for itself in just more than seven years. "That was very desirable from the county board's perspective and my perspective," he said.

The Need for New

A new justice center has been needed for some time. The county started saving money for future needs in the early '90s, and many factors contributed to the decision to expand. Public safety was considered above anything else, and the old buildings were not meeting the public's needs. The new justice center provides efficiency because all departments are in one place.

The Law Enforcement Center benefits from this setup due to the center's location near Mankato's major transportation corridors. This will improve emergency response times in rural Blue Earth County areas. It will also allow for increased backup should there be any disturbances at the jail.

Blue Earth County's plan started many years ago and it included the historic 120-year-old Blue Earth County Courthouse and other existing county facilities. The board

Fact Check

- There are 116 cameras in the facility
- The borefield contains 48 miles of HDPE pipe
- The building has 705 doors
- There are 329 locks that have to be checked weekly
- The facility will have an estimated energy savings of 24 to 32 percent

wanted to conserve energy on these buildings while the justice center was being built. By doing simple things like insulating ductwork and switching to compact fluorescent light bulbs, the old courthouse has earned an ENERGY STAR award consecutively since 2006.

GSHPs are not the only environmentally friendly feature in the new center. Other "green" areas include: water efficiency, sustainable sites, materials and resources, and indoor environmental quality. The water efficiency comes from things like rain gardens and a storm water retention pond. The center will also utilize low-flow toilets, urinals, faucets, sinks, showerheads and dishwashers that save an estimated 34 percent of water used, according to Blue Earth County's green design plan.

The Blue Earth County Justice Center is expected to have energy savings of 24 to 32 percent with an estimated payback of just more than seven years.

Preferred parking spots are designated for low-emitting, fuel-efficient vehicles and carpoolers, according to Tim Edwards, Blue Earth County's physical plant director. The center also makes use of local natural limestone, as well as recycled carpets, tiles and flooring. Indoor air quality is impacted by the inclusion of low VOC-emitting materials, Edwards said.

A geothermal system was the perfect addition to all the other "green" features, McCoy said. "The design of the geothermal system is very functional," he said. ◆

All photos courtesy of Blue Earth County.

AWEB Assists with Europe's Largest Lake Loop Project

By Janet F. Reeder

Europe's largest geothermal lake loop energy system recently was completed and commissioned at King's Mill Hospital in the Ashfield district of Nottinghamshire in Mansfield, England.

The United Kingdom hospital project designed by Geothermal International, uses Slim Jim® Geo Lake Plates®, according to Alan Watts, of AWEB Supply in Baton Rouge, La.

"What is unique about this project is that it is the largest of its kind outside of North America," Watts said. "The hospital is now healing patients while helping to heal the environment."

The system utilizes King's Mill reservoir, a medieval millpond expanded in the 1830s that once acted as a headwater for a dozen mills along the River Maun. It is now a spectacular wildfowl sanctuary, used extensively by the public and a local sailing club. Great care was taken to lessen the environmental impact of work at the lake. The King's Mill Reservoir Sailing Club assisted in guiding Seaflex floats used to carry plate installations to their locations.

The reservoir, separated from the hospital's grounds by a major highway, acts as the heat exchange for a 5.4MW cooling and 5MW heating system. The manifold is across the street from the hospital at the reservoir.

"Reverse return manifolds at the reservoir accommodate seven 200-ton Slim Jim® banks using directionally bored lines to the pumping room across the street," Alan Watts said.

Geothermal International is the UK's leader in design installation and commissioning of ground source energy efficient heating and cooling systems, according to Brian Davidson, chief executive of Geothermal International. Geothermal International is the UK distributor for WaterFurnace, and used their Series E units on the hospital project.

Watts says Geothermal International contacted AWEB about their Slim Jim® products after seeing one of their advertisements in *Geo Outlook* magazine.

"At the time that they were doing the hospital project," Alan Watts said, "they were also doing three other projects at Nottingham University."

Alan Watts, of AWEB Supply, helps Tim Tabers check one of the crates of custom designed and fabricated Slim Jim® lake plates that were sent to the King's Mill Hospital project in England.

Geothermal International engineers consulted with Watts and the two companies began work together on geothermal systems at the University of Nottingham projects. In 2007, Geothermal International approached, AWEB about the possibility of a license agreement for their products in the European Union. While they were pursuing that possibility, Alan Watts said Geothermal International representatives came to Louisiana to investigate potential uses for AWEB's Slim Jim® products on their current projects.

"We went to England and they took us to their different lake project sites," Barbara Watts said. "They are under the Kyoto Protocol," she said, "and they are so dependent on fossil fuel."

The Kyoto Protocol is a legally binding agreement under which industrialized countries will reduce their collective emissions of greenhouse gases by 5.2 percent compared to the year 1990, representing a 29 percent cut. National targets range from 8 percent reductions for the European Union and some others to 7 percent for the U.S., 6 percent for Japan, 0 percent for Russia, and permitted increases of 8 percent for Australia and 10 percent for Iceland.

One of seven 200-ton Slim Jim® Lake Plate banks is floated on buoys to a location in the King's Mill Reservoir as the geothermal system for the hospital is constructed.

An extension of the main campus of University of Nottingham was planned in honor of the Golden Jubilee of Her Majesty Queen Elizabeth II. As part of the plans, the Jubilee Campus of the University of Nottingham added three new iconic buildings, all of which demonstrate exemplary sustainable building practices.

The design process took into account site potential, energy demand profiles and site restrictions and determined the use of a geothermal system was the best way to maximize the development's potential for sustainable design and energy conservation.

AWEB assisted Geothermal International in custom designing and fabricating the Slim Jim® lake plates used by Jubilee. A lake-coupled reversible heat pump system that provides 100 percent of all heating and cooling requirements is submerged in an artificial lake created during development.

"All three of those buildings have our geo exchangers on them as well," Alan Watts said. "All of these buildings were anywhere from 80-tons to 100-tons each."

Barbara Watts said the Jubilee campus is not typical of the classical buildings prevalent throughout England. "It is really a unique campus because

when you think about England, you think about old buildings and a historical look. The new buildings are very futuristic looking," she said.

The buildings incorporate high-performance, highly insulated facades that are less than 50 percent glazed and oriented to ensure natural lighting without excessive solar gain. More than 250 smart meters monitor energy use and will assist in monitoring energy performance of the buildings.

Between the university and the hospital projects, Alan Watts says the two companies realized the importance of a partnership and entered into a license agreement by December 2007. Geothermal International now has exclusive distributor rights for Slim Jim® in the UK and the European Union.

For the King's Mill project, AWEB exported plates to the United Kingdom for 140 Slim Jim® 10-ton units, which Watts says were fabricated into the necessary seven 200-ton banks after being unloaded from shipping containers that had been carefully packed and loaded by AWEB representatives.

"The main thing we did was supply them with the plates," Alan Watts said. AWEB produced a special run of plates for the project. After consulting with him, and viewing fabrication methods used at several United States installations, Geothermal International started their work.

"They were already in the process of putting the plates together when we got there," he said.

The Mansfield, England hospital's ground-sourced heating and cooling technology will reduce carbon emissions and result in significant cost savings. A landmark installation for the Sherwood Forest Hospitals National Health Service Trust, the project will change the way hospitals are cooled and heated in the UK in the future.

King's Mill Hospital was originally an American Services Hospital during the Second World War. The major redevelopment of the facility is part of a $590 million effort involving three Nottinghamshire hospitals. The King's Mill project, a modern hospital with state-of-the-

art technology and equipment in a 140,000 square meter, 920-bed facility will be fully operational by 2011.

Alan Watts says that while the University of Nottingham and King's Mill Hospital projects are the first for AWEB in England, the company has previously had projects in Scotland.

"We are presently in 37 states, plus Canada is a large customer as well as several other countries around the globe," Alan Watts said.

"For every challenge there is a solution," Alan Webb said. "With our Slim Jim® product, we can go from a little 2-ton unit all the way up to, for instance, a project we are looking at right now that is 8,000-tons. The possibilities are endless."

Watts, who is an IGSHPA certified geoexchange designer and accredited installer, says that making geothermal as simple as possible has resulted in increased acceptance and involvement of contractors. ◆

Photos provided by Barbara Watts

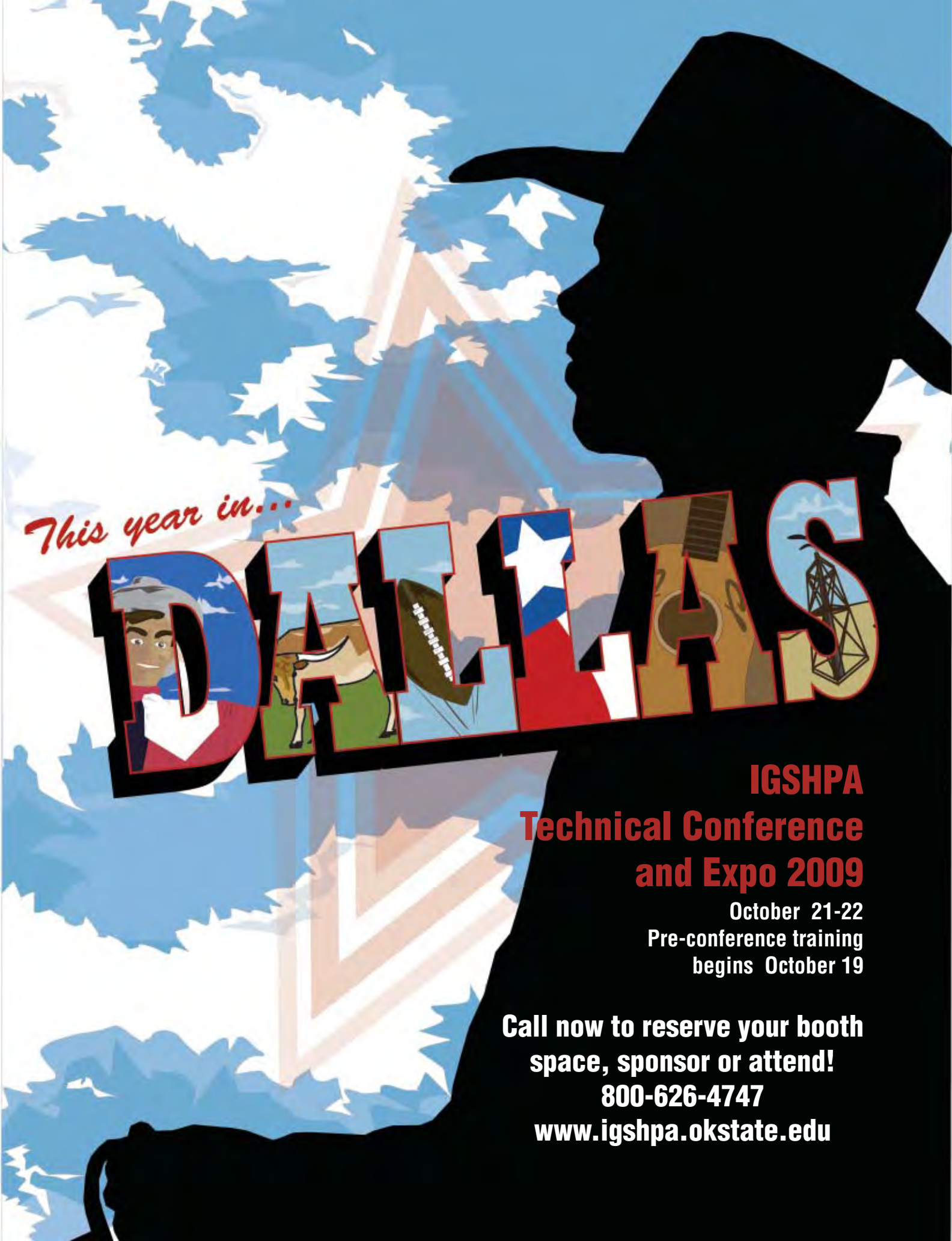
Earth Insights

If you have a question about geothermal installation, design or troubleshooting, send it to Phil Rawlings in care of *Geo Outlook*, Oklahoma State University, 374 Cordell South, Stillwater, OK 74078 or via e-mail to igshpa.news@okstate.edu.

It's Just a Filter

Ever wonder how something so simple can cause so many problems? Housing managers and maintenance personnel should know the answer. Without preventative maintenance programs to regularly check/change filters, discussions about filters with occupants typically go something like this; Filter?? It could also be "I change the filter?", "What filter?", or "Filter, where is it?" We've all heard it, but here are a few pictures to illustrate just how bad it can be – and it applies to any type of HVAC system, not just GSHP. Picture one is the return air grill that had furniture almost against it "Yeah, we seem to have a lot of dust bunnies." The matching filter is to the right of the grill. Two is a filter from Military Family Housing - examples like this are found far too often. Three is a filter so dirty it began to come apart as it was removed from a GSHP filter rack. Four is a GSHP unit where they used filters far too long, then TURNED THEM AROUND and after some period of time changed to a new one and did the same thing!! Five is interesting - this is the result of putting filter media in a ceiling return (not a filter grill) and forgetting it for who knows how long. And six, well, six is the mother of all dirty filters that was behind a sidewall return air grill (not a filter grill) for years and literally fell apart when found and removed. Let's solve this and make sure that owners and/or occupants are educated on filter location and filter change interval recommendations.

Mr. Rawlings has more than 30 years experience in the geothermal industry. He is a Certified GeoExchange Designer (CGD) and an IGSHPA Accredited Installer and Trainer.



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